

What is claimed is:

1. An apparatus for extending an optical fiber glass body, comprising:

an electric furnace for heating an extension  
5 optical fiber glass body to be extended;  
a first holding member positioned above said electric furnace, and holding a fix end of a upper portion of said extension optical fiber glass body to be extended;

a second holding member positioned below said  
10 electric furnace and holding a fix end of a lower portion of a pulling glass member;

a first axial center alignment mechanism provided between said electric furnace and said first holding member and for aligning an axial center of a tip  
15 of a free end of a lower portion of said extension optical fiber glass body; and

a second axial center alignment mechanism provided between said electric furnace and said second holding member and for aligning an axial center of a tip of  
20 a free end of a upper portion of said pulling glass member,

an axial center of said axial center alignment mechanism being met with an axial center of said second axial center alignment mechanism.

2. An apparatus for extending an optical fiber  
25 body according to claim 1, wherein said first axial center

alignment mechanism comprises

a pair of axial center alignment holders  
provided a pair of V-shaped grooves facing to a  
longitudinal direction of said extension optical fiber  
5 glass body at facing centers thereof, and having self axial  
center alignment function,

a pair of supporting bars provided at facing  
portions to support said pair of axial center alignment  
holders, and

10 a pair of bases having movement mechanisms for  
moving said pair of axial center alignment holders and said  
pair of supporting bars as a unit in a horizontal  
direction.

3. An apparatus for extending an optical fiber  
15 body according to claim 1, wherein said second axial center  
alignment mechanism comprises

a pair of axial center alignment holders  
provided a pair of V-shaped grooves facing to a  
longitudinal direction of said pulling glass member at  
20 facing centers thereof, and having self axial center  
alignment function,

a pair of supporting bars provided at facing  
portions to support said pair of axial center alignment  
holders, and

25 a pair of bases having movement mechanisms for

moving said pair of axial center alignment holders and said pair of supporting bars as a unit in directions of right and left.

4. A process of connecting and fixing an extension  
5 optical fiber glass body to be extended and a pull glass member in an apparatus for extending the optical fiber glass body, comprising: an electric furnace for heating the optical fiber glass body; a first holding member positioned above said electric furnace, and holding a fix end of a  
10 upper portion of said extension optical fiber glass body to be extended; a second holding member positioned below said electric furnace and holding a fix end of a lower portion of a pulling glass member; a first axial center alignment mechanism provided between said electric furnace and said  
15 first holding member and for aligning an axial center of a tip of a free end of a lower portion of said extension optical fiber glass body; and a second axial center alignment mechanism provided between said electric furnace and said second holding member and for aligning an axial  
20 center of a tip of a free end of a upper portion of said pulling glass member, an axial center of said axial center alignment mechanism being met with an axial center of said second axial center alignment mechanism,

said process including the steps of:  
25 provisionally fixing a fix end of a upper

portion of said extension optical fiber glass body to said first holding member;

holding a tip of a free end of a lower portion of said extension optical fiber glass body by said first  
5 axial center alignment mechanism and aligning an axial center of said tip of said free end;

holding and fixing said fix end of the lower portion of said extension optical fiber glass body by said first holding member;

10 releasing said pair of axial center holding members of said first axial center alignment mechanism and positioning the tip of the free end of said extension optical fiber glass body at a predetermined position in said electric furnace;

15 holding and fixing the fix end of the lower portion of said pulling glass member by said second holding member;

holding a tip of a free end of a upper portion of said pulling glass member by said pair of second axial  
20 center alignment mechanism having a self axial center alignment function to align the axial center of the tip of said free ends;

holding and fixing the fix end of the lower portion of said pulling glass member by said second holding  
25 member; and

releasing said pair of axial center holding members of said second axial center alignment mechanism and positioning the tip of the free end of said pulling glass member,

5                   to thereby coincide the tip of the free end of said extension optical fiber glass body and the tip of the free end of said pulling glass member to meet each axial center.

5.     A process of connecting and fixing an extension  
10   optical fiber glass body to be extended and a pull glass member in an apparatus for extending the optical fiber glass body, comprising: an electric furnace for heating the optical fiber glass body; a first holding member positioned above said electric furnace, and holding a fix end of a  
15   upper portion of said extension optical fiber glass body to be extended; a second holding member positioned below said electric furnace and holding a fix end of a lower portion of a pulling glass member; a first axial center alignment mechanism provided between said electric furnace and said  
20   first holding member and for aligning an axial center of a tip of a free end of a lower portion of said extension optical fiber glass body; and a second axial center alignment mechanism provided between said electric furnace and said second holding member and for aligning an axial  
25   center of a tip of a free end of a upper portion of said

pulling glass member, an axial center of said axial center alignment mechanism being met with an axial center of said second axial center alignment mechanism,

said process including the steps of:

5                   holding and fixing the fix end of the lower portion of said pulling glass member by said second holding member;

                  holding a tip of a free end of a upper portion of said pulling glass member by said pair of second axial  
10                   center alignment mechanism having a self axial center alignment function to align the axial center of the tip of said free ends;

                  holding and fixing the fix end of the lower portion of said pulling glass member by said second holding  
15                   member;

                  releasing said pair of axial center holding members of said second axial center alignment mechanism and positioning the tip of the free end of said pulling glass member,

20                   provisionally fixing a fix end of a upper portion of said extension optical fiber glass body to said first holding member;

                  holding a tip of a free end of a lower portion of said extension optical fiber glass body by said first  
25                   axial center alignment mechanism and aligning an axial

center of said tip of said free end;

holding and fixing said fix end of the lower portion of said pulling glass member body by said first holding member;

5 releasing said pair of axial center holding members of said first axial center alignment mechanism and positioning the tip of the free end of said extension optical fiber glass body at a predetermined position in said electric furnace;

10 to thereby coincide the tip of the free end of said extension optical fiber glass body and the tip of the free end of said pulling glass member to meet each axial center.

6. A process of connecting and fixing an extension  
15 optical fiber glass body to be extended and a pull glass member in an apparatus for extending the optical fiber glass body, comprising: an electric furnace for heating the optical fiber glass body; a first holding member positioned above said electric furnace, and holding a fix end of a  
20 upper portion of said extension optical fiber glass body to be extended; a second holding member positioned below said electric furnace and holding a fix end of a lower portion of a pulling glass member; a first axial center alignment mechanism provided between said electric furnace and said  
25 first holding member and for aligning an axial center of a

tip of a free end of a lower portion of said extension optical fiber glass body; and a second axial center alignment mechanism provided between said electric furnace and said second holding member and for aligning an axial center of a tip of a free end of a upper portion of said pulling glass member,

an axial center of said axial center alignment mechanism being met with an axial center of said second axial center alignment mechanism,

said process including the steps of:

provisionally fixing a fix end of a upper portion of said extension optical fiber glass body to said first holding member, and holding and fixing the fix end of the lower portion of said pulling glass member by said first holding member;

holding a tip of a free end of a lower portion of said extension optical fiber glass body by said first axial center alignment mechanism and aligning an axial center of said tip of said free end; and holding a tip of a free end of a upper portion of said pulling glass member by said pair of second axial center alignment mechanism having a self axial center alignment function to align the axial center of the tip of said free ends;

holding and fixing said fix end of the lower portion of said extension optical fiber glass body by said



first holding member; and

holding and fixing the fix end of the lower portion of said pulling glass member by said second holding member; and

5 releasing said pair of axial center holding members of said first axial center alignment mechanism and positioning the tip of the free end of said extension optical fiber glass body at a predetermined position in said electric furnace; and

10 releasing said pair of axial center holding members of said second axial center alignment mechanism and positioning the tip of the free end of said pulling glass member,

to thereby coincide the tip of the free end of  
15 said extension optical fiber glass body and the tip of the free end of said pulling glass member to meet each axial center.

7. An apparatus for extending an optical fiber body, comprising:

20 a upper holder for holding a upper end of an extension optical fiber glass body to be extended;

a lower holder, provided at a position coinciding an axial center with that of said upper holder and facing to said upper holder, holding a lower end of a  
25 pull glass member connected to a lower end of the

extension optical fiber glass body, an axial center of  
said pull glass member being coincided an axial center of  
said extension optical fiber glass body, and said lower  
holder being pulled toward a lower portion, in response  
5 to an extension of said extension optical fiber glass body;

an electric furnace, provided between said  
upper holder and said lower holder, heating said extension  
optical glass preform;

10 a moving means moving at least said lower  
holder toward a low position to pull said extending optical  
fiber glass preform; and

a control means,

15 said control means controls the following, when  
extending said optical fiber glass preform in said electric  
furnace, and after junction of the lower end of said  
optical fiber glass preform and the upper end of said pull  
glass member by heat-melting manner,

moving the maximum temperature portion of said  
electric furnace to the junction portion to heat and  
20 connect the junction portion, and

controlling said movement means to lower said  
lower holder, to thereby move the maximum temperature  
portion of said electric furnace from said junction portion  
to the extending portion of said optical fiber glass body.

25 8. An apparatus for extending an optical fiber

body according to claim 7, wherein a dummy member is connected to the lower end of said extension optical fiber glass body, a diameter of a lower tip of said dummy member being smaller than a diameter of the upper tip of said  
5 pulling glass member, a diameter of a upper tip of said dummy member being substantially equal to or close to a diameter of said extension optical fiber glass body, said dummy member has a semi-conical shape in the upper tip and said dummy member being formed by a material equal to that  
10 of said extension optical fiber glass body, and

wherein said control means controls the movement of said moving means to move said lower holder downward to thereby extend said extension optical fiber glass body connected to said dummy member at the lower tip  
15 thereof.

9. An apparatus or extending an optical fiber body according to claim 8, wherein said diameter of said lower tip of said dummy member is approximately  $1/2$  to  $1/3$  of the diameter of said upper end of said pulling glass  
20 member.

10. An apparatus for extending an extension optical fiber glass body, comprising:

a upper holder for holding a upper end of an extension optical fiber glass body to be extended;

25 a lower holder, provided at a position where

an axial center thereof coincides with and an axial center of said upper holder, holding a lower end of a pulling glass member a upper end of which is connected to a lower end of said extension optical fiber glass body to coincide both axial centers, and movable downward in response to the extension of said extension optical fiber glass body;

an electric furnace provided between said upper holder and said lower holder and heating said extension optical fiber glass body;

a temperature measurement unit for measuring the temperature of an extending portion of said extension optical fiber glass body;

a speed meter for measuring an extension speed of said extension optical fiber glass body after extension;

a moving means for moving at least said lower holder downward to pull said extension optical fiber glass body after extension; and

a control means;

said control means reads the temperature from the temperature measurement unit and the extension speed from said speed meter, and controls said moving means to continuously raise set extension speed to a predetermined steady extension speed from the beginning of the extension to the steady extension state.

11. An apparatus for extending an extension optical fiber glass body according to claim 10, wherein said control means controls the heat power of said electric furnace to raise the temperature of said electric furnace in response to the increase of said extension speed.

12. An apparatus for extending an extension optical fiber glass body according to claim 11, further comprising an extension shape measurement means for measuring a shape of said extending portion of said extension optical fiber glass body,

wherein said control means reads the shape information from said extension shape measurement means and controls the movement speed of said moving means to control said extension speed and the heat power of said electric furnace to control said heat temperature, to thereby maintain a meniscus angle of said extending portion, said meniscus angle being determined by said read shape information.

13. An apparatus for extending an extension optical fiber glass body according to claim 12, wherein said control means controls said moving means and said electric furnace so that said extending meniscus angle is kept 2 to 4 degree.

14. A method of extending an optical an fiber glass body in an electric furnace, the method including the step

of raising an extension speed of an extended optical fiber glass body to a predetermined extension speed, from the beginning of the extension to the steady extension state.

15. A method of extending of an optical fiber glass  
5 body according to claim 14, said method includes a step of controlling said extension speed so that a meniscus angle at an extending portion of said optical fiber glass body is kept 2 to 4 degree.

16. A method of extending an optical fiber glass  
10 body according to claim 15, said method includes a step of raising a heating temperature of the electric furnace in response to the raise of said extension speed.